



## PATENT COOPERATION TREATY

## PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/EP2003/000470	International filing date (day/month/year) 18 January 2003 (18.01.2003)	Priority date (day/month/year) 21 January 2002 (21.01.2002)
International Patent Classification (IPC) or national classification and IPC F24J 3/08		
Applicant WATERKOTTE WÄRMEPUMPEN GMBH		

<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>5</u> sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (<i>sent to the applicant and to the International Bureau</i>) a total of <u>5</u> sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> <p>4. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Box No. I Basis of the report</li> <li><input type="checkbox"/> Box No. II Priority</li> <li><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li><input type="checkbox"/> Box No. IV Lack of unity of invention</li> <li><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li><input type="checkbox"/> Box No. VI Certain documents cited</li> <li><input type="checkbox"/> Box No. VII Certain defects in the international application</li> <li><input type="checkbox"/> Box No. VIII Certain observations on the international application</li> </ul>
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Date of submission of the demand 31 July 2003 (31.07.2003)	Date of completion of this report 21 January 2004 (21.01.2004)
Name and mailing address of the IPEA/EP	Authorized officer
Facsimile No.	Telephone No.

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/EP2003/000470

## Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

- This report is based on translations from the original language into the following language \_\_\_\_\_, which is language of a translation furnished for the purpose of:
- international search (under Rules 12.3 and 23.1(b))
  - publication of the international application (under Rule 12.4)
  - international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

- the international application as originally filed/furnished

the description:

pages \_\_\_\_\_ 1-20, as originally filed/furnished

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

the claims:

pages \_\_\_\_\_, as originally filed/furnished

pages\* \_\_\_\_\_, as amended (together with any statement) under Article 19

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

pages\* 1-17 received by this Authority on 12 December 2003 (12.12.2003)

the drawings:

pages 1/2-2/2, as originally filed/furnished

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3.  The amendments have resulted in the cancellation of:

- the description, pages \_\_\_\_\_
- the claims, Nos. \_\_\_\_\_
- the drawings, sheets/figs \_\_\_\_\_
- the sequence listing (*specify*): \_\_\_\_\_
- any table(s) related to sequence listing (*specify*): \_\_\_\_\_

4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- the description, pages \_\_\_\_\_
- the claims, Nos. \_\_\_\_\_
- the drawings, sheets/figs \_\_\_\_\_
- the sequence listing (*specify*): \_\_\_\_\_
- any table(s) related to sequence listing (*specify*): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/EP 03/00470

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims	1-17	YES
	Claims		NO
Inventive step (IS)	Claims	1-17	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-17	YES
	Claims		NO

**2. Citations and explanations**

1) In view of the documents cited in the international search report, the subject matter of claim 1 does not meet the PCT requirements of novelty and inventive step (PCT Article 33(1)).

**1.1) Novelty**

The document DE79 36 659 U mentioned in the application, and considered to be the closest prior art, discloses (cf. figure 1) a heat source or heat sink installation with geothermal coupling for near-surface extraction of thermal energy from ground soil or for near-surface introduction of thermal energy into ground soil,

- the installation comprising at least one earth probe (1) disposed in the ground soil,
- thermal energy being either removable from the ground soil or deliverable into the ground soil by means of a heat transport fluid run through the earth probe (1),
- each earth probe (1) comprising a metal probe tube that is impervious to the surrounding ground soil and comprised of a plurality of

driven tube segments (2, 3) impact-driven into the ground soil, and with either a dip tube open at its lower end or a U-shaped loop tube disposed in the probe tube to carry the heat transport fluid in or out, and

- the first, front driven tube segment (3) of the probe tube incorporating or being sealingly connected to a probe tip (5) at its forward end.

The subject matter of claim 1 differs, then, from this known heat source or heat sink installation in that

- each driven tube segment is made of ductile cast iron,
- the driven tube segments are designed to fit into each other at their ends, and
- each driven tube segment has at its one end a conically tapered outer circumference and at its other end a stop shoulder collar with matching conical inner circumference, the diameter and angle of taper of which being dimensioned in such a way that the impact-driving of the driven tube segments provides for a tight, non-positive connection between the driven tube segments.

The subject matter of claim 1 is thus novel (PCT Article 33(2)).

#### 1.2) Inventive Step

The problem addressed with the present invention can be seen as that of designing a more efficient method of installing the earth probe. The conically tapered outer circumference at one end and the matching

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conical inner circumference at the other end of each driven tube segment as well as the use of ductile cast iron for manufacturing the individual segments enable a tight, non-positive connection to be created between the individual segments as they are driven in. In the prior art, on the other hand, the connection of two successive driven tube segments requires an additional operation (screwing together).

The subject matter of claim 1 thus involves an inventive step (PCT Article 33(3)).

- 2) Claims 2-17 are dependent on claim 1 and thus also meet the PCT requirements in relation to novelty and inventive step.

New Patent Claims of December 12, 2003

1. Heat source or heat sink system with thermal ground coupling for near-surface recovery of thermal energy from the ground or for near-surface discharge of thermal energy into the ground, wherein the system comprises at least one ground probe (1) arranged in the ground (3), wherein thermal energy can either be withdrawn from or discharged into the ground (3) by means of a heat transfer fluid supplied through the ground probe (1), wherein each ground probe (1) comprises a metallic probe shaft (2) that is tight against the surrounding ground (3) and consists of several drive-pipe segments (20) driven into the ground (3), and wherein either an immersion pipe (26) that is open at its lower end or a U-shaped pipe loop (29) is arranged in the probe shaft (2) for supplying or removing the heat transfer fluid,
- 10 characterized in that
- 20 - each drive-pipe segment (20) consists of ductile cast iron;
- the drive-pipe segments (20) are formed such that they can be fitted into each other at their ends (21, 22);
- 25 - each drive-pipe segment (20) comprises a tapered outer perimeter (21') at one of its ends and, at its other end, a sleeve (22) provided with a stop shoulder (22'') and having a mating tapered inner perimeter (22'), wherein their diameters and taper angles are dimensioned such that the drive-pipe segments (20), on being driven in, can be connected to each other in a force-closed and tight manner; and
- 30

- that the first advancing drive-pipe segment (20) of the probe shaft (2) is, at its forward end, designed with or tightly connected to a probe tip (23).

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2. System according to Claim 1, characterized in that each tapered outer perimeter (21') of each drive-pipe segment (20) is provided at the forward end (21) of said drive-pipe segment (20) and that the sleeve (22) of each drive-pipe segment (20) that is designed with the stop shoulder (22'') is provided at the backward end of said drive-pipe segment (20).
- 10
3. System according to Claim 1 or 2, characterized in that the outer diameter of the immersion pipe (26) is smaller than the inner diameter of the probe shaft (2) and that the length of the immersion pipe (26) is slightly smaller than the length of the probe shaft (2).
- 15
- 20
4. System according to Claim 1 or 2, characterized in that the length of the U-shaped pipe loop (29) extending up to the latter's U-bend is slightly smaller than the length of the probe shaft (2) and that the part of the interior region (28) of the probe shaft (2) that is not occupied by the pipe loop (29) is filled with a thermally conductive filling material.
- 25
- 30
5. System according to anyone of the preceding claims, characterized in that the last drive-pipe segment (20) of the probe shaft (2) is, at its backward end, tightly connected to a connection cover (24) attached

after completion of the drive-in procedure, with an inflow line connection (25) and a return flow line connection (27) for the heat transfer fluid being arranged on said connection cover (24).

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6. System according to Claim 5, characterized in that the immersion pipe (26) or the pipe loop (29) is solely mounted to or in the connection cover (24).

10 7. System according to anyone of the preceding claims, characterized in that the immersion pipe (26) or the pipe loop (29) comprises an air vent (29) or a vent valve at its upper end.

15 8. System according to anyone of the preceding claims, characterized in that the immersion pipe (26) or the pipe loop (29) consists of plastic material, preferably polyethylene (PE) or polypropylene (PP).

20 9. System according to anyone of the preceding claims, characterized in that the probe shaft (2) is driven into the ground (3) either in vertical direction or in an inclined direction preferably extending at an angle ranging from 15 to 75 degrees in relation to the vertical direction.

25 10. System according to anyone of the preceding claims, characterized in that the probe shaft (2) is driven into a borehole that has been predrilled into the ground (3), with the maximum depth of the borehole being as great as the length of the probe shaft (2) and with the diameter of the borehole being smaller than the outer diameter of the probe shaft (2).

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11. System according to anyone of the preceding claims,  
characterized in that the wall thickness of each  
drive-pipe segment (20), with the exception of the  
5 region at either of its ends (21, 22), ranges from 10  
to 20 percent of the outer diameter of the drive-pipe  
segment (20).
12. System according to anyone of the preceding claims,  
10 characterized in that each drive-pipe segment (20),  
with the exception of the region at either of its ends  
(21, 22), comprises an outer diameter approximately  
ranging from 80 to 200 mm and a wall thickness  
approximately ranging from 7 to 12 mm.
- 15 13. System according to anyone of the preceding claims,  
characterized in that the length of each drive-pipe  
segment (20) approximately ranges from 4 to 6 m and is  
preferably 5 m, and that the total length of the probe  
20 shaft (2) approximately ranges from 10 to 50 m and  
even more if this is permitted by the actual ground  
conditions.
14. System according to anyone of the preceding claims,  
25 characterized in that the heat transfer fluid is pure  
water, in particular without any antifreeze additive  
and in particular under a pressure of an order  
approximately ranging up to 10 bar.
- 30 15. System according to anyone of Claims 1 through 13,  
characterized in that the heat transfer fluid is  
carbon dioxide, in particular under a pressure of an  
order of approximately 100 bar and more.

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16. System according to anyone of the preceding claims,  
characterized in that each drive-pipe segment (20) is  
provided with an anticorrosive layer on its external  
and/or internal surface.

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17. System according to Claim 16, characterized in that  
the anticorrosive layer is formed by galvanizing or by  
a plastic coating, preferably of polyurethane (PU).

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